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PSYCHOLOGICAL LITERATURE.

I.—ACTION AND VOLITION.

BY PROFESSOR J. M. BALDWIN.

CHAUVEAU: *On the Sensori-Motor Nerve-Circuit of Muscles; Brain.* LIV. and LV., 1891, p. 145 ff.

This paper is an experimental attempt to establish a so-called Sensori-Motor Nerve-Circuit for the Muscles, i. e., a direct innervation of muscle due to a current passing up from the muscle by the sensory branch and down by the motor branch of its nerve. For this inquiry Chauveau uses two muscles of which the sensory nerve courses are isolated from the motor, the sternomastoid (voluntary) and the muscles of œsophagus involved in deglutition (involuntary). In the case of sternomastoid, Chauveau finds, operating on the horse, (1) excitation of the motor branch gives contractions with no sign of sensibility; (2) excitation of the sensory branch gives contraction, also slightly delayed. Conclusion: A connection between the central ends of the sensory and motor courses, i. e., a reflex "circuit." The same result appears when the branches are respectively cut. Excitation of the end of the motor branch which adheres to the muscle gives contraction; excitation of the corresponding sensory branch end gives no result, and excitation of the end of the fixed motor branch gives no result, of that of the fixed sensory end gives contraction; so that the commotion always travels one way in the circuit, up the sensory and down the motor branch. The only differences in the stimulation of the muscle from the centripetal as against the centrifugal course are that the former is delayed in time and requires a stronger current. Testing the same muscle by simple section, i. e., by the withdrawal of physiological support rather than by positive electrical excitation, the results are the same, except in one particular. As would be expected, cutting the motor nerve gave paralysis of the sternomastoid, but cutting of the sensory branch had no effect upon the muscle. "Section of the sensory branch does not abolish movement," and "I failed to obtain evidence of any alteration of function." The same experiments on involuntary muscles—those of œsophageal deglutition—gave the same results, except that last named. Here section of the sensory branch produced "sometimes transitory and irregular paralysis, sometimes a peristaltic incoordination." Chauveau notes that the difference between voluntary and involuntary muscles in respect to the effect of the absence of sensory nerve support contradicts the results of Claude Bernard, who by cutting a series of lumbar sensory roots in the dog obtained motor disturbances in the corresponding hind limb. He explains the contradiction on the ground of differences in the relative complication of the muscle in question with others in performing coordinate functions. The motor branch in one case may be excit-

able through its connection with the sensory branch at the same time that it is not dependent upon the sensory reports of the latter for its innervation: its connections with other sensory functions may still be sufficient. But in another case (Bernard's) it may be both excitable through and dependent upon the sensory reports.

It is evident that there is another possible explanation, i. e., that while sensory reports are sufficient for the regulation of involuntary movements, they are not sufficient for voluntary movement; these latter are regulated from a higher co-ordinating centre. This alternative Chauveau suggests and rejects, although he admits the physiological difference it requires, i. e., "one (muscle) is automatic, not influenced by the psycho-physiological centres, the other is a part of the voluntary locomotor system, influenced by these centres." The difficulty with his explanation is three-fold: (a) If the dependence of the motor function in question upon the support of the sensory branch be inversely as the degree of implication of other sensory connections, then the most complex and co-ordinated function, i. e., walking, would be most free from impairment when certain of these sensory connections are cut. Such relatively simple function as moving the head up and down upon the neck—due to the contraction of the sternomastoid—we would expect to be most impaired by cutting the sensory branch. (b) We may ask why such sensory support from other connections does not also avail to prevent impaired function in the case of the involuntary muscles? (c) Even though the kinæsthetic regulation by groups of sensory nerves be allowed, we would expect some impairment of function when the entire sensory contribution from the muscle in question is cut off; the amount of laming would be a matter of degree. But this is contradicted both by the result on the sternomastoid, and by Chauveau's experiments in cutting the four nerves supplying the toes of pigeons. He found that "complete sensory enervation of an extremity does not appreciably disturb these (the locomotor) functions," and "they roost indifferently upon the normal and upon the enervated foot." I may add, also, that these experiments upon the sternomastoid are valuable for the discussion of the regulation of voluntary movements, since all kinæsthetic support from "remote" sources (the eye, ear, etc.) are here ruled out.

Other interesting results are: Contractions of facial and lingual muscles by stimulating the nuclei, in the fourth ventricle, of the seventh and twelfth pairs; contraction of abdominal and spinal muscles by stimulating sensory cells of cord between the last dorsal and first lumbar root, after section of the cord from the brain (artificial respiration being carried on); co-ordinate respiratory movements in horses, after separation of the medulla from the encephalon, by stimulating the intercostal nerves. As to the mechanism of the sensori-motor circuit thus demonstrated, Chauveau criticises the ordinary kinæsthetic theory as being too complex, and adopts the view that there is a repulsive wave which runs toward the muscle along the sensory course, reaching the muscle simultaneously with the motor impulse, and regulating the muscular contraction.

WALLER, *The Sense of Effort; An Objective Study; Brain*. LIV. and LV., 1891, p. 179 ff.

Dr. Waller attempts to ascertain by experiment the locus of the sensation of fatigue after muscular work and thereby also the locus of the sensation of muscular effort; holding that the former is related to the latter as an after-effect to a first-effect, analogous to